Beattie, W.R.

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TOMATOES AS A TRUCK CROP

THE TOMATO, a horticultural crop of American origin, now ranks third in importance among our truck crops. The demand for high-quality table or slicing tomatoes is increasing, and there is need for improvement in the quality of the tomatoes grown for the early market.

Thousands of carloads of early tomatoes are shipped to our leading markets during the winter, spring, and early summer from the Southern States, Mexico, Bermuda, the Bahama Islands, and the West Indies. Great quantities of tomatoes are grown as an intensive truck crop throughout the Northern States by special methods of forcing, pruning, staking, and other means of producing an early or superior product. The production of tomatoes under glass is also an important industry.

Suitable soil, good seed, and well-grown plants are the foundation for the production of early tomatoes of high quality, and a number of seed firms are now making a specialty of strains and varieties that are adapted to the work. Marked progress has also been made in the development of strains that are resistant to disease.

Outstanding cases of truck growers who have been especially successful with tomatoes are frequently found, and this bulletin is largely a summary of their methods and results.

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TOMATOES AS A TRUCK CROP.

By W. R. BEATTIE, *Horticulturist, Office of Horticultural and Pomological Investigations, Bureau of Plant Industry.*

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INTRODUCTION.[1]

Fresh or table tomatoes are now to be had in the leading markets of the United States practically the entire year, the supply in the late fall, winter, and spring coming from the west coast of Mexico, Bermuda, the Bahama Islands, Cuba, the Southern States, and the great vegetable-forcing houses of the Northern and Eastern States. The summer and early fall supply comes from the thousands of truck gardens and farms scattered over a wide area, especially in the North-Central and Northern States. According to the 1919 census, the area devoted to early and truck-crop tomatoes in the United States was 120,000 acres, exclusive of those grown for canning and manufacturing. The present need of the early and truck-crop tomato industry is not increased acreage but a general improvement in the growing, grading, packing, and marketing of the crop.

Fresh tomatoes are shipped in car lots from more than 25 States, but the bulk of the early table stock comes from 8 States. The 5-year average for the period ended with 1921 credits Florida with 4,596 cars a year, New Jersey 2,627 cars, California 2,102 cars, Mississippi 1,431 cars, Texas 1,378 cars, and Tennessee 694 cars. Figures are not available to show the great quantities of fresh tomatoes sold locally and those produced in home gardens and used in the homes. The production of early fresh tomatoes in the Southern States is more or less localized, while the general market-garden and truck crop of the North-Central and Northern States is very generally and widely distributed.

In Florida the important early-tomato sections are around Miami and from Boynton to Florida City, around Palmetto, near Lake

[1] The tomato industry of the United States is naturally divided into more or less distinct branches, according to the use made of the product: (1) The truck and general market-garden crop, including the early table tomatoes grown in the Southern States and those grown for the market throughout the country; (2) the production of tomatoes for canning and for manufacturing; and (3) the production of tomatoes under glass, this latter being simply a special phase of table-tomato production. This bulletin contains information relative to the growing of early, midseason, and late tomatoes for the general market. Farmers' Bulletin 1233 treats of the growing of tomatoes for canning and manufacturing. Farmers' Bulletin 1291 gives information upon the grading, packing, and shipping of early tomatoes. Another bulletin will treat of the growing of tomatoes under glass. Early and truck-crop tomatoes are grown in areas varying from small patches to large acreages, the total for the United States, according to the 1919 census, being about 120,000 acres, exclusive of those grown for the canneries.

Okeechobee, and in the central and north-central parts of the State. In Mississippi the early-tomato industry is located mainly around Crystal Springs and Hazlehurst. In Texas early tomatoes are grown extensively around Alto, Jacksonville, Tyler, and other points in the eastern part of the State. Most of the shipments from California originate near Los Angeles. In Tennessee the towns of Humboldt, Gibson, and Milan hold first place in tomato shipments. Marietta, Ohio, and Anna and Cobden, Ill., are important early-tomato producing points. New Jersey, with the town of Swedesboro as a leading shipping center, supplies the eastern markets with great quantities of midseason fresh tomatoes. In the New England States the market garden tomato industry centers around Boston, Providence, New Haven, Hartford, and other points. Rochester and Buffalo are important centers in New York; and Ashtabula, Cleveland, and Toledo in northern Ohio. In fact, midseason tomato production is highly developed around every important market of the North-Central and Northern States except the extreme Northwest, where climatic conditions are not so favorable for tomatoes.

Exceptional results in the production of fancy table tomatoes are often obtained by members of boys' and girls' clubs and by truck gardeners, who follow the practice of growing 1,000 to 10,000 plants either in pots or in special beds and setting these on one-tenth of an acre to 1 acre of well-prepared land. By this system the plants are set closer than in regular field culture and are pruned to a single stem and tied to stakes or to a trellis. Cases are reported where more than $6,000 worth of tomatoes have been sold from an acre during a season by this method of culture. Results like this are extremely exceptional, however, and are obtained only under the very best conditions.

SOILS ADAPTED FOR GROWING TOMATOES.

Tomatoes may be grown on a wide range of soil types, but a warm, well-drained, and fertile soil is essential for earliness, high quality, and grade. A large part of the southern early-tomato crop is produced on sandy loam soils having a clay subsoil and capable of being worked very early in the spring. Land that is slightly rolling, or which has a gentle slope toward the south or southeast, or which is located where it has the protection of a thick piny woodland or a hill to the north is considered ideal from the standpoint of earliness. In New Jersey, Delaware, Maryland, and others of the Atlantic Coast States truck-crop tomatoes are grown for the most part on sandy loam soils, the selection of the land being made with early maturity of the crop prominently in mind. In the Northern and Mid-Western States tomatoes are planted on almost all types of soil, those of a loamy or sandy loam character being given preference.

Profitable tomato culture is largely dependent upon the soil on which the crop is grown being in the proper physical condition. Heavy soils and those that are poorly drained or which are plowed while too wet seldom yield a profit. Soils that are deficient in organic matter or that are in need of lime are not satisfactory for the production of tomatoes. Plant food can be added in the form of fertilizers, but no amount of concentrated plant food will atone for a run-down and poor physical condition of the soil.

CROP ROTATION.

Crop rotation is a matter of great importance in tomato growing, regardless of soil type or locality. Land on which manure was applied to a cultivated crop the previous season or which has grown a crop of clover or other soil-building crop is preferable. Tomatoes should not follow tomatoes, and the rotation should not include potatoes, peppers, or eggplant, as these are liable to transmit the diseases affecting the tomato. Certain weeds that are closely related to the tomato, such as ground cherry or husk tomato (Physalis) and horse nettle (*Solanum carolinense*), are thought to be carriers of certain tomato diseases, and land infested with these weeds should not be planted to tomatoes. Nematodes, or gallworms, are particularly troublesome on many of the sandy soils of the South and many loam soils of the North, causing gall-like formations on the roots of the tomatoes, as shown in Figure 1. It is impracticable to recommend a definite crop rotation that will be adapted for all localities, but in general tomatoes should be grown in a rotation covering at least four years and including one cultivated crop in addition to the tomatoes and one or more soil-building crops. The important considerations from the standpoint of crop rotation are the avoidance of loss from disease and the securing of high yields and quality. In some localities this may be accomplished by a 4-year or 5-year rotation, but in others a much longer cycle or rotation may be required.

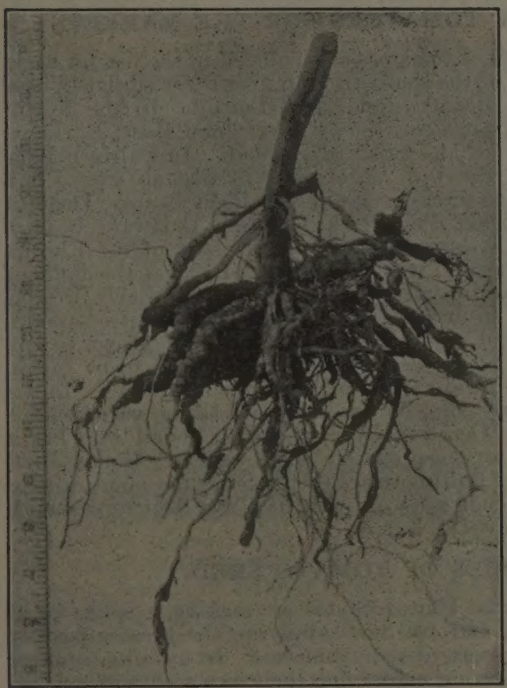

FIG. 1.—Root of a tomato plant affected with root-knot, caused by nematodes, or gallworms.

In Florida the tomato fields are allowed to grow up in heavy grass during the summer, this being either cut for hay or plowed under as a soil-improvement crop. In Texas and Mississippi tomatoes are followed the same season with sweet potatoes, peanuts, velvet beans, or cowpeas. In Indiana, where considerable acreages

of tomatoes are pruned and tied to stakes, it is customary to pinch the heart out of the plants after about four clusters of fruit have been formed, and after the early fruit is marketed a hill of Kentucky Wonder beans is planted by each stake and the beans allowed to climb upon the stakes and the old tomato vines. In the New England States the fruiting season for tomatoes usually extends almost until frost, and there is little opportunity for intercropping or the planting of soil-building crops. With a limited supply of manure it becomes necessary for growers to rely more upon soil-building crops and rotations that tend to build up the soil.

VARIETIES OF TOMATOES FOR THE MARKET.

Eight or ten varieties of tomatoes are included in the list for early growing, but the bulk of the southern crop grown for shipment consists of Globe, Acme, Beauty, and Early Detroit. In the North-Central and Eastern States the Bonny Best, John Baer, Earliana, Greater Baltimore, Acme, and Stone are leaders. In California the Stone is most generally grown. Other varieties that are grown in a limited way all over the territory are the Redfield Beauty, Duke of York, Trucker's Favorite, June Pink, Coreless, Delaware Beauty, and Early Jewel. It is estimated that 90 per cent of the Florida crop is of the Globe variety, which, however, often has the fault of being puffy and containing air cavities. Acme and Early Detroit are grown extensively in eastern Texas, and these varieties produce fruit of medium size but very solid. Earliana is not grown to any extent in the extreme South, as its fruits are inclined to be rough, and the yield is not so good as that of some other varieties. In the northern section Bonny Best is one of the leading varieties for staking and pruning. Occasionally a grower is found who has a market for Ponderosa or some similar large variety. Bonny Best, John Baer, and Greater Baltimore are the varieties recommended for northern growing, although a few growers have excellent success with Earliana and Early Jewel.

SOURCES OF TOMATO SEED.

Some seed firms in the United States are making a specialty of high-class tomato seed and are now supplying the greater part of the seed used by the growers of early tomatoes. In a limited number of cases growers are selecting and saving their own seed with marked success, but this is the exception and not the rule. Seed firms growing selected seed under personal supervision are in a position to supply the tomato growers of a given section with seed of a practically uniform strain, thus insuring reasonable uniformity of the product at shipping time. The Florida section is a notable instance where about 90 per cent of the crop is grown from seed of the variety known as Livingston's Globe, the seed, however, not all being furnished by one firm but by several. Another notable instance is that of the California early tomato growers who plant the variety known as Stone, which runs reasonably true to type and strain.

In view of the fact that the quality, strain, and trueness to variety type of the tomato seed used by truck growers have such an important bearing upon the earliness, yield, and uniformity of the crop, no pains should be spared in obtaining the best, and the original

cost should be of secondary consideration. The fact that certain growers are paying extremely high prices for specially grown and selected tomato seed, however, does not justify the seed dealer in charging the grower more than high-grade seed of uniform strain is worth on the market. In view of the fact that only about 2 ounces of tomato seed are required to produce plants with which to set an acre, the grower can well afford to pay a fair price, provided he gets the quality he is paying for. In no case should miscellaneous or canning-factory seed be used, but only high-grade seed of known quality. Some growers follow the practice of purchasing their supply of seed a year in advance and testing a small quantity to see that it is true to variety and type. Where this is done special care should be taken to protect the seed from moisture while it is held in storage.

Marked progress has been made by the workers of the United States Department of Agriculture and others in the development of disease-resistant varieties and strains of tomatoes. The effort has been mainly to obtain varieties that are immune to Fusarium wilt, a disease that is especially prevalent in the Southern States. Several varieties have been developed, but the one known as Norton is perhaps the most widely distributed and has given as high as 90 per cent resistance on land where standard varieties proved a failure on account of the presence of wilt. In sections where the wilt does not occur the standard varieties of tomatoes are usually to be preferred. It is recommended, however, that growers having strains of tomatoes particularly adapted to their local needs give special attention to the further perfecting of these, and that where wilt is present one or more of the resistant sorts now available be tried.

METHODS OF STARTING EARLY TOMATO PLANTS.

The profits derived from the growing of early tomatoes are dependent upon getting the product on the market while prices are high, and the first essential to earliness is the production of strong well-grown plants having the first bloom upon them by the time they are set in the open ground. In order to do this the seed should be sown indoors in a small hotbed or in a greenhouse. In Florida, where the growing season is practically continuous throughout the year, the seed is often planted in the field where the plants are to remain, or the seed is sown in a bed where it can be watered and the plants transferred to the field when they attain suitable size. Eastern Texas growers sow the seed in small hotbeds which are usually flue heated and transplant to cloth-covered beds and later to the field. The system followed in Mississippi is similar to that of eastern Texas. The growers of early outdoor tomatoes in the Northern States start the plants in greenhouses or hotbeds and handle them in pots or boxes prior to setting in the open. Some of the most successful northern growers complete the indoor growth of the plants in 6-inch clay pots such as are used by florists. By keeping the plants cool and well ventilated toward the last of their indoor period of growth they become very strong and stocky, having a wonderful root system. In view of the importance of producing good plants for the early-tomato crop, this phase of the work will be discussed under several headings and in considerable detail.

HOTBEDS AND COLDFRAMES.

Hotbeds and coldframes should always be located in a sheltered place, either on a south slope, as shown in Figure 2, on the south side of a building, or where protected by a clump of low-growing pines. Where small native pines are abundant these can be used to create an artificial shelter by planting a temporary hedge of them on the north and west sides of the bed. In eastern Texas and in Mississippi coldframes to which the plants are transplanted are usually located in the center or alongside each acre on which the tomato crop is to be grown. In the Northern States the coldframe is generally located near buildings or on a southern slope where it

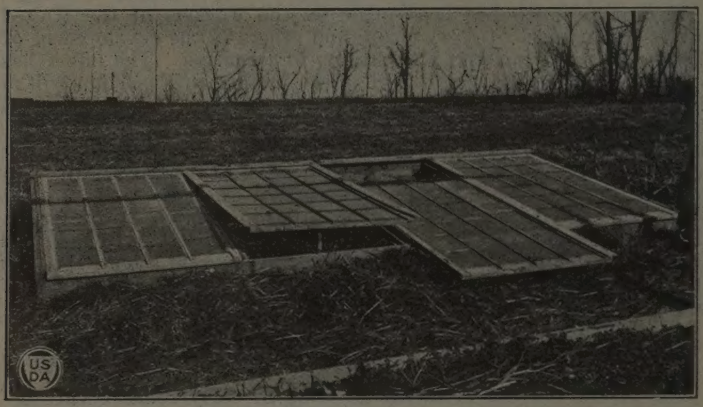

FIG. 2.—A hotbed suitable for starting early tomato plants.

will get the greatest benefit from the sunshine and be protected from the wind.

The eastern Texas and Mississippi growers as a rule employ a flue-heated hotbed for starting the seedling tomato plants. This type of bed is constructed by digging a pit about 3 feet deep, 6 feet in width, and 12 or 14 feet in length along the side of a south slope or small hill and as near the house as practicable. A flue is then built the length of the pit, using loose field stones or bricks for its construction. A chimney or metal smoke flue is provided at the opposite end from the furnace, and the pit is covered with a board floor and provided with 10-inch or 12-inch plank or concrete sides. The covering for these beds consists either of sash or of heavy muslin tacked to a roller and supported on crosspieces nailed to the top of the plank sides. Heat is provided by burning stumps, trash, or partly seasoned wood that will give a slow even heat. About 6 or 8 inches of good sifted loam is spread upon the floor of the bed and the seeds planted in rows crosswise of the bed, the rows being spaced about 4 inches apart. In a few instances the plant bed is located alongside the house and heated from the hot-water, steam, or hot-air heating system of the dwelling, but in this case the bed is usually made in the form of a lean-to or pit on the south side of the dwelling,

as shown in Figure 3, and is used for other purposes in addition to starting tomato plants.

Manure-heated hotbeds are constructed in the same manner as the flue-heated beds except that the pit for the manure is only about 12 inches in depth and without the raised floor required in the flue-heated beds. The heat is provided by tramping a layer of horse or mule manure in the bottom of the pit to a depth of 6 to 12 inches, according to location, time of winter, and the outside temperature that must be reckoned with. The manure should be reasonably fresh and free from burning or previous expenditure of its heat. Prior to putting it into the bed the manure should be stacked in a low flat pile and turned over once or twice in order to start uniform heating.

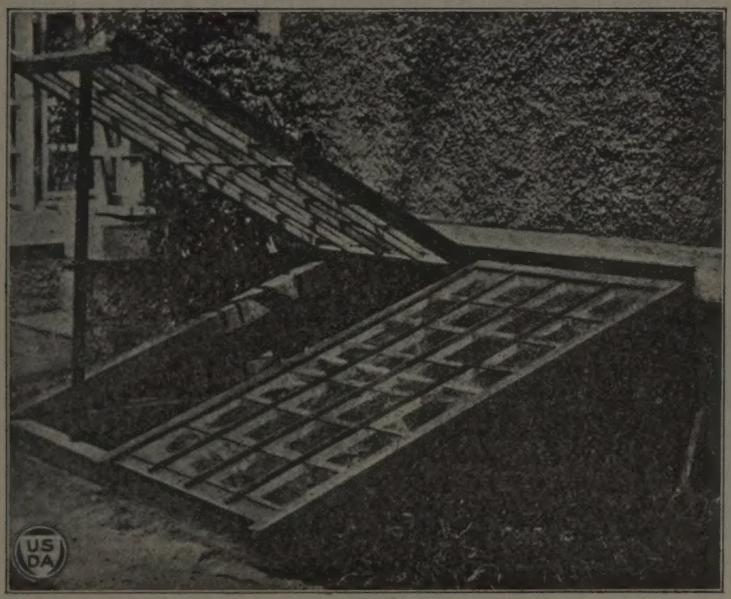

FIG. 3.—Pit attached to a residence and heated by the home-heating plant.

If the manure is very dry, a small quantity of water should be sprinkled over it while being turned. The manure should not be forked into the bed in large masses but should be shaken through the tines of a fork in thin even layers all over the bed. As each layer is spread it should be tramped moderately, and after the placing of the final layer the entire bed of manure should be well tramped. Following the placing of the manure in the bed, about 6 inches of good sifted-loam soil should be spread over the entire surface. A manure-heated bed should be made several days before the date for sowing the seed, in order that it may heat to its highest point and the temperature recede to 85° F. or lower before the seeds are sown.

The coldframe in most general use by the growers of Texas and Mississippi is 10 by 60 feet in size, with a ridgepole through the

center, sloping ends, strips or rafters to support the cover, and 8 to 10 inch boards for the sides. As a rule the bed is located right on the land where the crop is to be grown, one bed of the above specified size setting 5,400 plants 4 by 4 inches, or enough plants to set 1 acre. The covering for these beds consists of heavy unbleached muslin sewed together to form a large sheet. This is spread over the bed and fastened to the ridgepole by nailing a strip of wood over it. The edges of the sheet are clamped between two strips of wood running the full length of the bed and forming rollers upon which to roll the sheet to the ridge from either side. The ends are held down by loops of tape sewed to the sheet and fastened over nails driven into the ends of the bed. A good idea of a bed of this type can be gained from Figure 4. As an added precaution against a sudden

FIG. 4.—Type of coldframe used by the tomato growers of Texas and Mississippi for growing early plants after starting the seedlings in the hotbed.

drop in temperature a quantity of light prairie hay or pine straw is provided, and if necessary this is spread over the sheet to a depth of 2 or even 3 inches. In removing the straw covering a large broom is used. In some instances it has become necessary to hang lighted lanterns inside the frames during cold nights.

Many of the growers of early tomatoes in the section lying too far north for the use of the cloth-covered coldframes but not so far north as to require great protection for their beds have found the use of hotbed sash and straw mats sufficient. Usually the beds are well banked on the outside with fermenting manure to keep out the cold.

A number of growers of early tomatoes in New Jersey have provided permanent concrete beds which are heated by means of hard-coal burning hot-water boilers and a system of pipes under and around the bed. The usual custom is to place the heater in a pit at one end of the bed or often in the basement of an outbuilding to

which the bed is attached. These beds are often made 20 by 40 or 20 by 60 feet in size and are used mainly for starting sweet-potato plants, a small portion only being used for tomatoes. The covering for these beds is either heavy muslin, light canvas, or sash. The heater pipes are carried from the boiler through the center of the bed and return around the outside. In a few cases heater pipes are either buried in the soil or run through 3-inch tiles laid in the bottom of the bed and covered with a foot or more of soil. The first cost of a bed of this character is high, but if properly built it will last for a great many years and is very effective and economical in its operation. A bed of this type is shown in Figure 5.

In the Northern States, where greater protection is necessary, the growing of plants requires the use of greenhouses or heated frames.

FIG. 5.—Permanent concrete bed provided with hot-water heater used by a New Jersey grower for starting early plants. The heater is located in the basement of the building in the background.

A brick or concrete pit 18 to 24 inches in depth covered with ordinary hotbed sash and located along the south side of a greenhouse from which it can be heated is perhaps the ideal method of growing early tomato plants.

One of the most successful growers of early tomatoes in northern Massachusetts finishes his tomato plants in 6-inch pots in a low greenhouse formerly used for growing cucumbers. This house has both top and side ventilation, making it possible to grow stocky plants. A tomato plant of this type is shown in Figure 6. To produce 8,000 to 10,000 such plants will require a space 8 by 8 inches for each, or 4,000 square feet of bed space. By using 5-inch pots and crowding the plants a little 10,000 plants can be carried on 2,500 square feet of bed surface, but it should be borne in mind that in order to grow good plants plenty of space must be provided.

GROWING TOMATO PLANTS.

Tomato seed sown in a hotbed in eastern Texas or in Mississippi from January 28 to February 15 will produce plants for setting in

the field in six to eight weeks; usually in about 50 days. Some growers plant the seed earlier than this, but it is better to keep the plants growing rapidly from the start rather than have them too early and then become checked. The time of sowing seed, however, will vary with the locality and must be determined by the time that the plants can be set in the field. The seed should be sown in rows about 4 inches apart, 6 or 7 seeds to the inch, and covered half an inch deep. After the seeds have been covered the surface of the soil should be watered with a sprinkling can, being careful to distribute the water uniformly over the bed. This watering will settle the soil about the seeds and also supply the necessary moisture to sprout them. During bright days a bed that is covered with sash will heat very quickly, and it will be necessary to ventilate either by sliding the sash partly off the bed or by tilting the side opposite to the wind. In the case of a cloth covering, it should be rolled part way up or lifted on the side opposite the wind. Toward evening the bed should be closed, so as to retain the heat for the night. Watering should be done only when necessary, as excessive or careless watering will cause the plants to damp-off at the surface of the ground or make a soft growth. Watering should be done early in the day, so the plants will dry off before the bed is closed for the night. The seed bed should not be allowed to dry out, but great care must be exercised both as to the quantity of water and the time of applying it. The usual practice is to have a barrel or two of water at the plant bed and apply the water as needed, using an ordinary 10 or 12 quart sprinkling can.

FIG. 6.—A good pot-grown tomato plant ready for setting in the field.

Work should be started on the preparation of the coldframes immediately after sowing the seed in the hotbed. If these beds are to be located in the field, the land should be first plowed, then the framework put in place. The next step is to scatter about 10 quarts of fertilizer over the surface of the 10 by 60 foot bed and work this into the upper 4 inches of soil with a spading fork. The bed should

then be left to settle for several days, or until the plants in the hotbed are ready to transplant. A day or two before transplanting begins the muslin cover should be fastened on the bed and the surface of the soil raked to a smooth, fine texture. Two or three barrels of water should be hauled and placed at a convenient point alongside the bed; also about two loads of marsh or prairie hay or its equivalent in pine straw should be piled near the bed. Two boards 1 inch thick, 12 inches wide, and just a little less than 10 feet long, so that they will drop into the bed crosswise, will be required to work upon while setting the plants. A row of small pegs, 4 inches apart, nailed to the edge of one of these boards will serve as a marker and form the holes in which to set the plants. Some growers, however, prefer to have a separate marker consisting of a 1 by 3 inch lath to which the pegs are fastened, as better openings in the soil are made with this type of marker than with the board.

Tomato seedlings will be ready to transplant from the hotbed to the coldframe in 12 to 18 days after sowing the seed, depending upon the amount of sunshine and the care given the bed. The plants first have the two seed leaves with which they come through the ground. A day or two later the first regular leaf begins to develop, and when the plants have their second regular leaf in addition to the seed leaves they will be ready for transplanting. The hotbed should be ventilated freely, or the covering removed entirely on bright days, to harden the plants before transplanting. A calm cloudy day is preferable to a windy bright day for transferring the plants from the hotbed to the coldframe. Before starting to lift the plants they should be watered, so that the soil will adhere to their roots. The plants should be lifted carefully by running a trowel or a thin paddle under them and placed in shallow boxes for transferring to the coldframe.

Tomato plants should be set in the coldframe about an inch deeper than they stood in the soil of the hotbed. Special care should be taken to see that the soil is well firmed about their roots and that the tops stand straight and uniform. Water should be sprinkled over the plants as fast as the rows are set, the quantity applied depending upon the moisture content of the soil. If the soil of the coldframe is too dry it should be watered the day before transplanting, but due consideration should be given weather conditions, as showers are liable to occur frequently at that time of the year. Two men can easily transplant one coldframe in a day if everything is in readiness.

Following transplanting, the tomato plants should be kept well shaded with the cloth covering for a day or two until they recover. In case the sunshine is bright the cover should be raised along the edge, but the plants should not be subjected to strong wind. During cold or rainy weather the covers are kept battened down tight to the frames, and in case of freezing, the straw covering is put on early in the afternoon. During bright weather the curtains are rolled up, usually on one side only at first, in order to protect the plants from the wind. The object of the grower is to keep the plants growing strong and stocky right from the first and to avoid extremes of temperature or moisture conditions. As the time for setting in the field approaches, the covering is kept off most of the time to harden the plants to outdoor conditions.

In the North-Central States the tomato seed is sown in flats in the greenhouse from February 20 to March 10. The plants are first

pricked off into other flats and later into pots, or they are handled in 2-inch pots at first and then shifted to larger pots as growth and root development proceeds. Tomato plants grown in pots are liable to become root bound, and it is often necessary to shift to pots as large as the 6-inch size in order to prevent serious checking of the growth. One-quart berry boxes are sometimes used as containers for early-tomato plants; also paper pots, paper bands, and wood bands. Pieces of inverted sod are sometimes used as a base for growing the plants, these being transferred to the field with the plants. Clay pots give the best results, but these are not normally practicable for use on a larger scale than for planting 2 or 3 acres.

FIG. 7.—A good transplanted tomato plant ready for setting in the field.

Watering pot-grown plants requires skill and frequent attention, in order that the soil may neither dry out nor become waterlogged. A good plan in potting the plants is to place a few pieces of a broken pot on some small stones over the drainage hole in the bottom of each pot. This will insure good drainage and aeration of the root system. Paper pots require even greater care than clay pots to avoid overwatering.

The proper spacing of the potted plants on the greenhouse bench or in the coldframe is of vital importance in the production of strong stocky plants. Where the plants are transferred directly into the soil of the coldframe they should be given at least 4 inches in each direction and then set in the field before they crowd each other. A plant grown in a coldframe and in proper condition for planting in the field is shown in Figure 7.

PREPARATION OF LAND.

Land on which tomatoes are to be grown is usually plowed three or four weeks before time to plant, in order to give opportunity for thorough preparation and for the application of manure and fer-

tilizers. In a few cases the land is plowed in the fall and left exposed over winter. Thorough and reasonably deep plowing is essential, and where any grass is to be turned under a chain or colter should be used in order to cover it completely. The greater part of the harrowing and pulverizing work should be done shortly before planting, however, the preparation of the soil depending considerably upon the kind of fertilizers or manure used and also on the locality and the method of growing the crop. No special tools other than the regular plows, harrows, and cultivators of the ordinary farm are required for growing a crop of tomatoes. One of the most important tools, in addition to the plow, is a disk harrow, with which to cut and pulverize the soil. Some of the best tomato growers follow the practice of disking their soil four to six times previous to planting.

MANURES AND FERTILIZERS.

Practices governing the use of manures and commercial fertilizers for tomatoes vary with the locality and the soil. Many growers prefer to apply manure to the crop preceding tomatoes rather than to the tomato crop itself. The growing period of the tomato is comparatively short; therefore, it is necessary that its plant-food supply be in a quickly available form, and this is not the case with fresh manure. Moderate quantities of well-rotted stable manure may be applied in the rows or worked into the soil for the early tomato crop, but should be supplemented with readily available plant food in the form of fertilizers. The application of large quantities of stable manure is liable to produce excessive vine growth at the expense of the setting of early fruit.

Coarse or fresh manure as a rule should not be worked into the soil in preparing for planting tomatoes, but if used it should be applied six months or a year in advance, preferably in connection with a crop of corn or some heavy-feeding crop. By this method the manure will become thoroughly decomposed and mixed with the soil before the tomatoes are planted. Compost, or rotted manure, may be applied to advantage on most soils at the rate of 4 to 6 tons to the acre in the furrows or 8 to 10 tons if broadcasted. Where the manure is applied in furrows under the rows it should be thoroughly mixed with the soil by means of a single-shovel plow or a narrow cultivator. A double furrow is then thrown over the manure, making a sort of bed, which is leveled with a plank drag just before setting the plants. Growers of staked and pruned tomatoes sometimes apply a mulch of about 2 inches of fine, strawy manure about the plants. This not only holds moisture but keeps down weeds and supplies the plants with considerable plant food.

Practices involving the use of stable manure for growing tomatoes in the southern Florida district, especially around Miami, are decidedly different from those described above. In that section the land is extremely wet during a portion of the year, and it is often a problem to get it dry enough for early planting. In order to overcome this difficulty a small quantity of manure is placed under each plant. This manure provides a dry footing for the plant, improves the drainage of the soil immediately under and around the plant,

and at the same time provides food for the early growth of the plant.

Commercial fertilizers play an important part in the growing of the southern early-tomato crop, from the fact that manure is scarce and fertilizers give the plants a supply of quickly available plant food. The quantity and composition of the fertilizers, however, vary under different conditions. A formula in common use contains 4 per cent nitrogen, 8 per cent phosphoric acid, and 4 to 6 per cent potash. Some growers use a formula of 2–8–2, such as is used for cotton and corn, then top-dress with 150 to 250 pounds of nitrate of soda to give the plants a rapid growth. In Florida a 5–5–5 fertilizer is sometimes used, in some cases a 4–8–6 formula being employed. The quantity of commercial fertilizer applied by the Florida growers varies from 800 to 2,000 pounds per acre, the rule being 1,200 or 1,400 pounds to the acre.

With the present scarcity of manure, the market gardeners of the Northern and Eastern States are coming to depend more and more upon commercial fertilizers. The quantity applied and its composition vary with the locality, but most of the tomato growers of the northeastern section are applying 800 to 1,400 pounds of a fertilizer having an analysis of 3 to 4 per cent nitrogen, 8 per cent phosphoric acid, and 6 per cent potash.

Commercial fertilizers are in some cases sown broadcast over the entire surface, but as a rule from one-third to one-half the total quantity is sown in the rows and the remainder broadcasted. Where all the fertilizer is applied in the rows under the plants special care must be taken to mix it thoroughly with the soil to avoid injury to the plants. On land on which 8 to 10 tons of rotted manure has been broadcasted or 4 to 6 tons placed under the rows it is customary to mark off the rows with a 3-row or 4-row marker, then distribute the fertilizer in a strip about a foot in width along the row, using a 1-horse fertilizer distributor with a fan-shaped device underneath to spread it. The fertilizer is then mixed with the soil by means of a cultivator.

In the southern Florida tomato district commercial fertilizers are applied throughout the growing season. Where only one side of the row is cultivated, as is often the practice, the fertilizer is applied in small furrows. First, about a week or 10 days after the plants are set a handful of fertilizer is placed on one side of the plant and generally left uncovered. Ten days or two weeks later more fertilizer is applied between the plants in the original planting furrow. A shallow furrow is then turned over this fertilizer. This forms a support for the plants. The third application is placed in the furrow made when the second application is covered. As many as five applications are made in this manner, the fertilizer being applied just beyond the feeding roots with a view to keeping the plants constantly supplied with plant food.[2]

Where nitrate of soda is applied as a top-dressing, not more than 150 pounds should be used to the acre at one time, and not more than two applications should be made. The first application should be made about 10 or 15 days after the plants are set in the field and the

[2] Sando, Charles E. The process of ripening in the tomato, considered especially from the commercial standpoint. U. S. Dept. Agr. Bul. 859, 38 p., 3 fig., pl. 3–4. 1920. Literature cited, p. 32–35.

second one, if made at all, about the time that the plants have set their fourth cluster of fruit. The nitrate of soda should not come in contact with the plants, nor should it be scattered too closely about their roots but uniformly distributed over a strip of ground about a foot wide on either side of the plants and cultivated into the soil.

PLANTING IN THE FIELD.

Tomato plants should not be set in the open ground until danger of frost is over. Many growers make the mistake of setting their plants a little too early, and as a result they are injured by cold and checked in their growth. While it is true that well-grown tomato plants will often go through a temperature of 1 or even 2 degrees below the freezing point, they are certain to be injured by such exposure, and it is best to wait until the weather and soil are reasonably warm before setting out the plants.

In eastern Texas planting in the field is usually done about the first or second week in April. Occasionally the season is so far advanced that the plants can be put out the last week in March, but April 10 is considered the frost-free date for that section. In Mississippi the season is usually 10 days later. In northern sections the time for outdoor planting varies with the location, but for the most part ranges from May 1 to 15, May 10 being considered the ruling frost-free date for the region in which these early tomatoes are grown. As 3 to 5 acres constitute about the average area planted by an individual grower in Texas or Mississippi, it is possible to handle the entire setting in the field within a week's time; in fact, it is desirable to have the setting all done within a short period, in order that the fruit may mature at the same time. In Florida, where acreages are much larger, planting begins in the late autumn for winter fruiting, but as a rule the big planting is made in January. The product of this goes upon the market during the spring months, ahead of the Texas and Mississippi crops.

Too much stress can not be placed upon the importance of having the soil well prepared before starting to plant. Under the term "preparation" are included plowing, harrowing, the application of manure and fertilizers, as previously described, and finally the opening of the furrows or the holes in which the plants are to be set. Where the manure and fertilizer have been placed directly in the rows it is customary in disking or harrowing to leave 3 or 4 feet of the original mark at the ends of the field as a guide for relocating the rows at planting time. A single-shovel plow or a very small turning plow is generally employed for opening the rows ahead of the planting. Another method is to mark the field in both directions with a 3-row or 4-row marker and then set the plants in the intersections with planting trowels. In a few cases the plants are being set with transplanting machines the same as are used for tobacco and sweet potatoes.

PLANTING DISTANCES.

Planting distances vary with the locality and the method of cultivation. The usual planting distances in the Texas and Mississippi districts are 3½ feet between the rows, with the plants 24 to 30 inches

in the rows. At 30 inches in the row approximately 5,000 plants will be required to set an acre. In Florida, where the plants are not pruned or tied to stakes, the planting distances are 4 by 4 feet, although some growers plant 3 by 4, 4 by 5, and various other distances.

In the Miami district the tomato plants are frequently set 2 to 3 feet apart in rows that are 6 feet apart. Another method is to have a 6-foot space between two rows, then a 2 or 3 foot space, the narrow row being allowed to grow to weeds, which partially support the plants of the two rows. While this method may prove reasonably satisfactory under conditions in the Miami district, it can hardly be considered a good cultural practice.

About 3,000 plants to the acre are required for planting according to Florida methods, the land being marked in both directions and cultivation conducted both ways until the plants begin to cover the ground. In New Jersey the plants are set 3 by 4 or 4 by 4 feet apart. Where tomatoes are grown by the most intensive pruning and staking methods, as for example in the New England States, the plants are set in double rows 18 inches apart each way with a 3½-foot space between that and the next double row. By this method 8,000 to 10,000 plants are set on an acre.

SETTING THE PLANTS.

The plant bed should be thoroughly watered a few hours before the plants are lifted. Where a hose is not available it is a good plan to have two or three barrels of water alongside the bed, and while the plants are being lifted the soil should be kept reasonably wet so that it will adhere to their roots. In Texas and Mississippi, where the plants are grown 4 by 4 inches apart in the coldframe, a large knife or trowel is used to cut between the plants in both directions. A square-pointed or planting trowel is used for lifting the plants, and they are taken up with a block of earth about 4 by 4 by 5 inches in size adhering to their roots, as shown in Figure 7. As the plants are lifted from the bed they are placed upon small board platforms about 30 by 30 inches in size having handles extending at both ends so that two men can carry them. These carriers hold about 40 plants each and are carried or hauled to the place where the plants are to be set. In the case of the field coldframes used in the Southwest, the sides and framework of the bed are removed before beginning to lift the plants, as shown in Figure 8. When the area has all been set except that occupied by the coldframe, this space is replowed, the rows extended through it, and the plants set so that they become a part of the field, the framework and coverings of the bed being hauled to the barn and stored until the following year.

Everything should be in readiness for planting and the crew organized the day before the plants are to be set in the field. In the tomato fields of eastern Texas it has been found economical to have a crew of seven or eight persons to do this work. The equipment for planting should consist of a horse and small plow to open the furrows, a claw hammer and pinch bar for removing the coldframe, a sprinkling can and two or three barrels filled with water, three or four planting trowels, five or six platforms or shallow trays for car-

rying the plants, two hoes for filling the soil about the plants, and a cultivator with which to cultivate the soil between the rows after the plants have been set. Wheelbarrows are sometimes used for carrying the plants from the bed to where they are to be set, but have the disadvantage that in wheeling them over the plowed ground the shaking loosens the soil from the roots of the plants. The horse or mule used for opening the furrows, if a quiet one, may be left standing at the end of a row when not needed. One man opens the furrows as required and waters the plant bed; one or two men lift the plants from the plant bed and place them on the carriers, as shown in Figure 8. Two men are required to carry the plants from the bed to the field where one or two persons take them from the trays and set them in the ground, placing a little soil around each plant, as shown in Figure 9. The plants should be set about 2 inches deeper in the field than they were in the plant bed. One or two men follow the plant setters with hoes and draw the dirt about the plants.

FIG. 8.—Removing tomato plants from a coldframe for setting in the field.

Immediately upon the completion of the setting the field is cultivated and the soil worked well around the plants.

In case the plant bed is located at a distance from the field, low flat-top wagons are used for hauling the plants to the field, and as they are lifted from the bed the plants are placed in shallow boxes or on board forms about 24 by 30 inches in size, these being constructed of light material so as to be easily handled. These boxes or forms are placed on the wagon, which is driven through the field, and the plants taken from the wagon as they are set. By this system three or four hands can make fair progress setting the plants. If the land is very dry and it is necessary to water the plants as they are set an additional team and two laborers will be required.

In setting pot-grown plants the most rapid progress can be made by removing them from the pots at the plant bed, this being done by inverting the pot and jarring its edge on the side of the bed or something reasonably solid. The plants are then packed in trays and hauled to the field. This method works very well where the plants have formed a matted-root system, but when the plants have

not formed sufficient roots to hold the ball of earth together it will be advisable to transport the plants to the field in the pots, removing them as the plants are set. Plants grown in berry boxes are taken to the field in them, and when ready to set a knife is used and the boxes are cut away from the roots of the plants.

CULTIVATION.

Tomatoes require frequent shallow cultivation, especially during the first four weeks of their growth in the field. The surface soil should be loosened as soon as it is dry enough after every rain. Hand hoeing between the plants in the rows is necessary after practically every cultivation, and all weeds should be kept out, as they not only rob the soil of plant food and moisture, but certain weeds are carriers of diseases that attack the tomato. The tools required for the cultivation of tomatoes consist mainly of the types used in

FIG. 8.—Setting coldframe-grown tomato plants in the field.

general farm and garden cultivation. Riding cultivators, such as are adapted for cultivating corn, are often used in the fields prior to the time that the tomato plants begin to spread over the ground. Where the plants are check planted cultivation can be maintained in two directions, thus almost entirely eliminating hand hoeing. In eastern Texas and in Mississippi 1-horse cultivators and sweeps are employed for the most part. An A-shaped cultivator having about 14 small teeth or a standard 5-shovel cultivator with two or three sizes of shovels will answer every requirement. Care must be taken to avoid deep cultivation near the base of tomato plants trained to stakes or other forms of support, as the feeding roots run close to the surface and there is not the protection and shading of the vines that are afforded where they spread naturally upon the ground. As already mentioned, a number of the northern growers of early tomatoes place a mulch consisting of about 2 inches of fine straw-

bedding manure along the rows. This mulch not only retains moisture but stimulates the growth and protects the shallow root system of the plants from the heat of the sun.

Cultivation of the tomato crop is discontinued by the growers in eastern Texas and in Mississippi about the time they begin to pick fruit. In case of a heavy rain during the picking period, which extends over a period of four or five weeks at most, a cultivator is sometimes run through the middles of the rows to loosen the surface and hold the moisture. New Jersey growers keep up cultivation until the vines begin to cover the ground, making further cultivation without injury impossible. Where irrigation is practiced by the growers of fancy tomatoes at the North, the soil is cultivated within a few days after each watering. Where tomatoes are pruned and tied to stakes in the home garden or club garden a wheel hoe is ideal for cultivation. The main point of cultivating tomatoes is to keep the surface soil loose and mellow and the ground entirely free from weeds.

IRRIGATION.

Irrigation of early tomatoes is not practiced to any great extent in the Southern and Eastern States. Market gardeners of the North-Central and Northeastern States, however, frequently plant an acre or two of tomatoes under overhead irrigation. The moisture requirements of the tomato are such that artificial watering is seldom necessary in humid regions during seasons of normal rainfall. During excessively dry seasons, however, the gardener who has irrigation facilities and applies a moderate quantity of water will be in the market late in the summer when tomatoes are bringing a good price. Knowing when and how much water to apply to the tomato crop is the determining factor in the matter of irrigation, as an excess of moisture often does more harm than good.

In arid or semiarid districts the usual method of applying water to other crops may be used for tomatoes. Care must be taken, however, to avoid overwatering, causing the shedding of the blossoms. Subirrigation by means of lines of tiles laid about 18 inches below the surface has been found ideal for tomatoes, as this method permits the application of water to the roots while the surface soil remains dry. Where tomatoes are watered on the surface of the ground it is essential that proper cultivation and the loosening of the soil should follow.

STAKING AND PRUNING.

Growers of early tomatoes in Texas, Mississippi, and a number of other sections in the Southern States follow the practice of pruning the plants to a single stem and tying them to stakes. The growers of Florida and southern Georgia, where the acreages are much larger, still allow the plants to grow naturally upon the ground, however, though some are trying the staking and pruning method on a small scale. The growers of the Northeastern States frequently prune and tie an acre or two, but most of the tomatoes grown for the markets of this section are left upon the ground. In a few northern sections tomato growers follow a practice known as "leaf pruning," but grow the plants in the usual manner upon the ground.

The stakes used by the southern tomato growers are either split from pine logs, cut from sawmill edging, or consist of small saplings cut in the woods. They are usually 3½ to 4½ feet long and sharpened at one end so they may be easily driven into the ground. The stakes should be gotten out during the early winter and hauled to the field where the tomatoes are to be set. It is customary to choose a straight-grained pine tree, cut it into sections of the desired length, and then split it into slabs or bolts that are easily handled. A double-bladed ax is then stuck firmly into the stump and the stakes split by striking the slabs upon the exposed blade of the ax. In this way the stakes are gotten out very rapidly.

Immediately after the plants are set a stake is driven beside each, the stakes being kept in line in the row and about 3 inches from the

FIG. 10.—Tomato plants being grown by the pruning and staking method.

base of the plant, as shown in Figure 10. Wooden mallets are generally used for driving the stakes, to avoid splitting them. The tying of the tomato plants to the stakes should begin immediately and be repeated every week or 10 days until about four tyings are made. Soft jute string, known in the tomato regions as "tomato twine," is used for tying. This string comes in large twisted hanks and can be cut off in short sections of about 9 or 10 inches as required. Raffia is also used extensively for tying tomatoes, especially by the northern growers. In tying, the string is passed around the stake and crossed between the stake and the stem of the plant, as shown in Figure 11. The roughness of the stake is generally sufficient to prevent the soft jute string from slipping down, and the stems should be drawn up close to the stakes. It is a good plan to form the tie just below a leaf, but this is not essential.

Early-tomato growers of the northern sections employ various methods of supporting the plants. Some use stakes 5 to 6 feet in length driven into the ground, others employ light bamboo stakes and tie them to wires at the top, as shown in Figure 12, while other growers use a regular trellis of posts and wires, as shown in Figure 13. The growers around Boston as a rule prune to two stems and tie to heavy strings which are supported by overhead wires. Many of the growers of the Central States use a combination of posts, wires, and lath stakes to support their tomatoes.

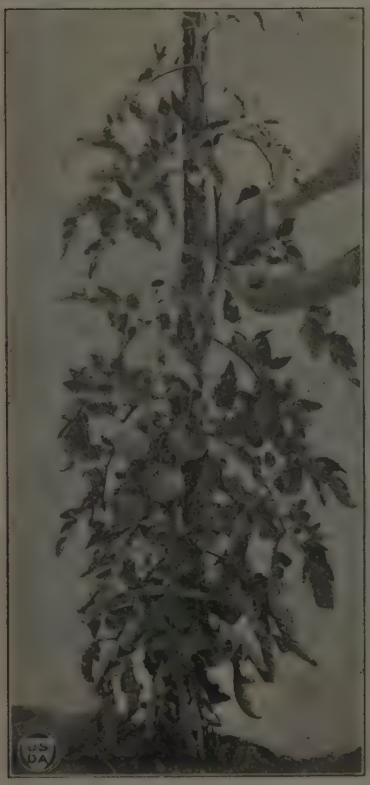

FIG. 11.—A tomato plant pruned to a single stem tied to a stake.

Pruning tomatoes, as commonly practiced, consists of cutting or pinching out all side branches as they appear about the base of the plant or in the axils of the leaves. Careful observation will show that the side shoots appear in the axil, or pocket formed by the leaf where it is attached to the main stem, while the fruit clusters are on the opposite side from the leaf and often a little above or below the point where the leaf is attached, as shown in Figure 14. The side shoots should be removed at least once a week during the active growing period, in order to throw all the vigor of the plant into the formation of fruit. In Texas and Mississippi the heart of the plant is pinched out after four or five good clusters of fruit have been formed. This practice of pinching out the heart of the plants is also followed in some of the North-Central States where it is desired to market only the early crop.

Growers of early tomatoes around Buffalo, N. Y., New Haven, Conn., and elsewhere in the Northeastern States follow a practice known as "leaf pruning" to stimulate the early formation of the branches and the setting of a large number of fruit clusters. This is contrary to the single-stem method and consists of pruning away all the leaf except the inner two lobes or segments while the plants are from 6 to 8 inches in height. After the branches have started no further leaf pruning is practiced, and the plants are allowed to grow upon the ground in the usual manner. This system, it is claimed, causes the tomatoes to ripen 5 to 10 days earlier and at the same time gives a heavy yield of early fruit. In view of the

fact that no definite experiments have been reported it is impossible to state the advantage, if any, to be gained by this method, though it is practiced by a considerable number of growers of early tomatoes.

INSECTS AND DISEASES.

The tomato is subject to the attacks of a number of insects and diseases which require prompt attention on the part of the grower. The insects that are most destructive are cutworms, tomato hornworms, the tomato fruitworm, and flea-beetles. The diseases that are most injurious are leaf-spot, early and late blight, mosaic, blossom-end rot, and Fusarium wilt. The following brief suggestions[3] are intended to serve as first aid to the grower, but where there is any considerable insect or disease infestation more detailed information should be obtained either from the agricultural college and ex-

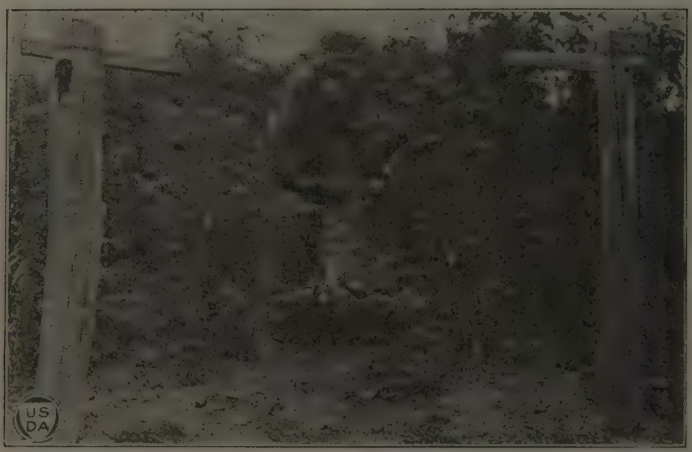

FIG. 12.—Tomatoes trained to light bamboo stakes which are supported by wires at the top.

periment station of the State in which the grower resides or from the Bureau of Plant Industry or the Bureau of Entomology of the United States Department of Agriculture, depending upon whether the trouble is caused by diseases or insects. A number of Federal and State bulletins which include information upon insects and diseases of the tomato are available, and the grower is advised to procure these in advance and fully inform himself as to what insect and disease troubles he is liable to encounter.

Several forms of cutworms attack young tomato plants both in the plant bed and when they are set in the field, usually cutting them off at the surface of the ground. The best control measure is by the use of what is termed "poisoned bait." This is made in the following manner: To 1 peck of dry bran add 4 ounces of white arsenate,

[3] For more detailed information see Department Circular 40, Insect Enemies and Diseases of the Tomato.

Paris green, or other arsenical. Add 2 quarts of cheap molasses and enough water to make a wet mash. After the mash has stood for several hours scatter it very thinly about the base of the plants late in the evening. Apply a second or third time if necessary.

Tomato hornworms are large green worms 2 to 4 inches in length, shown in Figure 15, sometimes called tomato worms or tobacco worms, which feed equally well on both tomato and tobacco plants. They are the larvæ or young of large moths, known as sphinx moths, of two species, very similar in habits and distribution. These insects produce two broods, and the worms eat the leaves from the tomato plants. Hand picking is recommended, but hornworms are so near the color of the foliage that they are difficult to locate even on the plants from which the leaves have been partially stripped. Where the worms are especially abundant the plants should be sprayed with arsenate of lead at the rate of 2 pounds of the dry or 4 pounds of

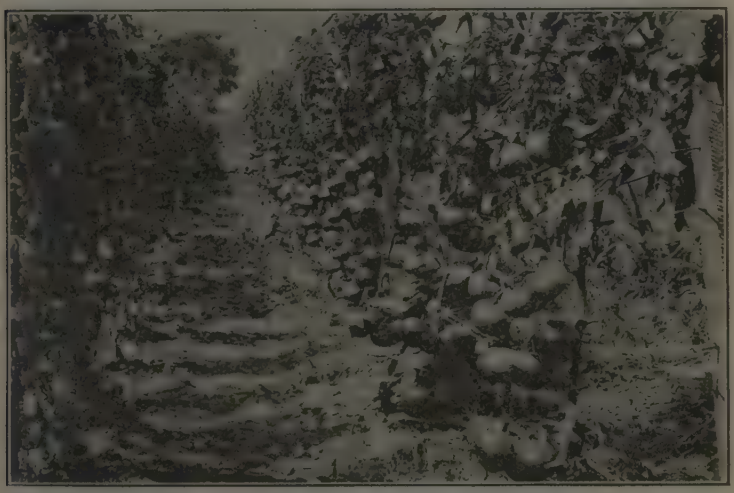

FIG. 13.—Tomato plants trained on wire trellises.

the paste form of the arsenical to 50 gallons of water, or the arsenate may be added to Bordeaux mixture used to control tomato blight.

The tomato fruitworm is the same insect as the bollworm (not the boll weevil) of cotton and the corn earworm. (Fig. 16.) This insect causes heavy losses of early tomatoes by its eating into the fruits and destroying their market value, as shown in Figure 17. Spraying the tomato fruits three or four times with lead arsenate, in the same proportions as given for hornworms, will almost completely control the tomato fruitworm. The first spraying should be done when the earliest tomato fruits are about an inch in diameter and repeated at intervals of a week or 10 days until the fruits are almost full grown. The spraying for the fruitworm can also be combined with applications of Bordeaux mixture.

Flea-beetles often cause great damage to the plants in the hotbed and coldframe or when they are first set in the field. The presence

of flea-beetles on the young tomato plants will be made known by the appearance of the leaves, the injured ones being lighter in color and pitted with small holes. Spraying the young plants with 1½ pounds of the dry form of lead arsenate in 50 gallons of water affords considerable protection. Bordeaux mixture acts as a deter-

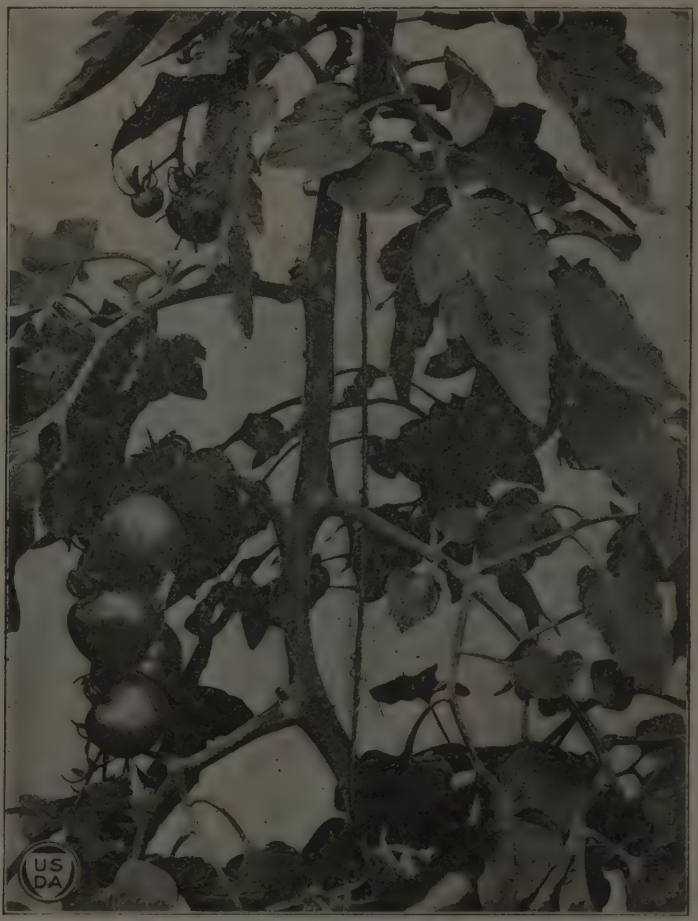

FIG. 14.—Section of a pruned tomato plant, showing the location of leaves and fruit clusters on the main stem.

rent, and it is a good plan to combine the arsenate with it. Dusting the plants lightly with dry air-slaked lime or with nicotine sulphate dust is effective in controlling flea-beetles.

Leaf-spot is a disease in which the leaves, beginning at the base of the plants, become covered with dark-brown spots and then shrivel

and die. Spraying with Bordeaux mixture and resin-fishoil soap before the disease gains headway, repeating the spraying every 10 days, is effective. In spraying it is important to cover the lower side of the leaves as well as the upper side. The 4–4–50 formula for Bordeaux mixture is most commonly employed, with 3 to 4 pounds of resin-fishoil soap added to each 50 gallons. Dissolve 4 pounds of bluestone in 25 gallons of water and slake 4 pounds of lime in a small quantity of water and dilute to 25 gallons. Pour the two solutions together and add the resin-fishoil soap, which has previously been dissolved by adding a few drops of hot water at a time, stirring well until the sticky soap is dissolved. The soap causes the Bordeaux

FIG. 15.—One of the tomato hornworms (*Phlegethontius sexta*): *a*, Adult moth; *b*, larva; *c*, pupa. (Howard.)

mixture to spread and to stick better to the shiny smooth surface of the leaves.

Early-blight, which causes a rapid blighting of the leaves and decay of the fruit, is due to a fungus. There are two forms of this blight. One causes a spotted discoloration of the fruit known as nail head and is only skin-deep. This disease is especially prevalent in the South. The other form causes a black decay which extends to the center of the fruit. This form of the disease is especially troublesome in the North. Spraying with Bordeaux mixture is the control measure usually recommended.

Late-blight, which also causes a blighting of the leaves accompanied by rotting of the fruit, is due to the same fungus that causes potato late-blight. Spraying with Bordeaux mixture is also a preventive for this disease.

Mosaic produces on the leaves mottled areas of different shades of green and sometimes crinkles and distorts the leaves, causing the plants to be weak and unfruitful. There are various types of this disease. The fern-leaf type, in which the leaves become very narrow, and the shoe-string type, in which the leaves develop only as long strings, are the most important.

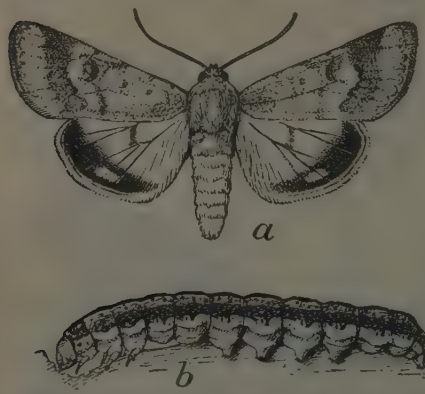

FIG. 16.—The tomato fruitworm, bollworm, or corn earworm (*Chloridea obsoleta*): *a*, Moth, or adult; *b*, larva. About natural size. (Howard.)

Mosaic is readily transmitted from plant to plant by lice and other insects and also by contact. Plants grown in greenhouses, where there are older tomatoes affected with the disease, while not showing any trace of the mosaic when moved to the field, will invariably develop it later. The disease is readily carried from one plant to another in pruning and tying. When mosaic once appears there is very little that can be done to eradicate it, the main point being to exercise extreme care in the growing of plants and to avoid transferring it to the field.

Blossom-end rot, a decay of the fruit at the blossom end, as shown in Figure 18, though not clearly understood, appears to be connected with the physical condition of the soil on which the crop is grown. While many growers believe that this disease has its greatest development during periods of deficient moisture supply, experiments have failed to show that irrigation will control it. Mulching the ground around the tomato plants is thought by many growers to be a preventive, but the effectiveness of this treatment has not been adequately proved in experiments.

FIG. 17.—Tomato fruitworm, showing its characteristic work. (Quaintance and Brues.)

The wilts of tomatoes are especially prevalent in the South, where about three forms of the disease are found. Fusarium wilt causes the plants to wilt and die slowly, while bacterial wilt causes the

plants to die suddenly. The planting of wilt-resistant strains or varieties applies especially to the control of the Fusarium wilt. The important considerations in the growing of tomatoes in sections where wilts prevail are to plant the tomatoes only on land (1) that is free from these diseases and (2) that has not grown weeds closely related to tomatoes. Care must be taken also that the soil of the plant bed is clean and free from wilt. The variety of tomato known as Norton is perhaps the best adapted for growing in sections where Fusarium wilt is widespread.

GATHERING AND PREPARING THE CROP FOR MARKET.

Early tomatoes grown in the Southern States and those imported into the United States during the winter months are gathered before they are fully ripened, on account of the shipping distance and the time required for them to reach the markets. Two stages of maturity are recognized, depending upon the length of haul and method of shipment: "Green" stock, the individual tomatoes of which are gathered before they show any pink color, wrapped in thin paper, and shipped in ventilator cars; "pink" stock, which shows varying degrees of color, is seldom wrapped, and is shipped under refrigeration where the time required to reach the market is more than 24 hours. The tendency in the Southern States during recent years is more and more toward the production of green stock for distant marketing. The green wrapped tomatoes usually carry better, and refrigeration costs in most cases are saved. Where the haul exceeds 8 or 10 days the green wrapped stock is shipped in refrigerator cars without ice but under ventilation during transit for the first five or six days, and then iced to destination.

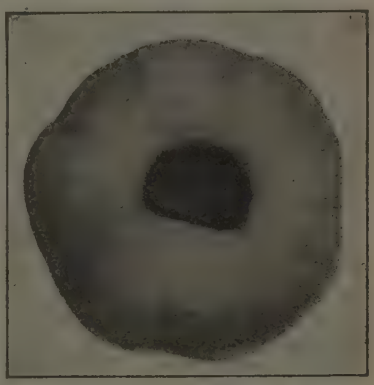

FIG. 18.—Tomato blossom-end rot.

Tomatoes that are picked and shipped in the green state do not have the same flavor and quality as those that either become pink or completely ripened upon the vine. For this reason, it is essential in gathering the green stock that they reach as complete a stage of maturity as possible. In the past the pickers of green tomatoes, especially those in the southern Florida districts, have not given proper attention to the maturity of the fruits, the size being the main determining factor, and as a result these tomatoes have gone through a ripening process either before shipment or after reaching their destination. The future of the green-tomato industry depends to a considerable degree upon remedying the present careless methods of gathering the fruit.

No definite rules have been established for determining the maturity of the fruits gathered for green shipment. The most common

and practical test is to cut a few average tomatoes crosswise of the seed cells with a sharp knife, and if the pulp that surrounds the seeds has become slightly jellylike, so that the seeds give way before the edge of the knife and are not cut in slicing, they are ready for shipment as green stock. The persons doing the picking soon learn to recognize the proper stage of maturity by color and general appearance. The size of the tomato fruits is no guide to the maturity, as it is the age of the tomato that determines its development. Color and general appearance vary to some extent with different varieties; here again the experience of the pickers must be relied upon. Toward the end of the picking season green tomatoes have a greater tendency toward internal coloring than they have earlier, and for this reason they should be handled more promptly. This is undoubtedly due to extremely hot weather and the exhausted condition of the vines. The tomatoes also as a rule will run smaller toward the end of the picking season.

When it comes to gathering pink stock, color is the main determining factor of maturity. Uniformity of color is extremely important, and it is often difficult to obtain a pack of pink stock that will run uniform. During the height of the shipping season picking should be frequent, every second day or every day, in order to have the fruits uniform and to avoid overripeness. Green stock can be picked twice the first week and three or four times a week thereafter. In many sections the picking is practically a continuous process, the vines being gone over as often as possible and no fruits allowed to become too far advanced.

It should be understood that pink stock shipped 700 or 800 miles under refrigeration as a rule will be ripe enough for use by the time it reaches the consumer, but that the green stock either ripens in transit without icing or is placed in a ripening room when it reaches its destination. In any case it is essential that the green stock be repacked, the riper fruits being placed in packages by themselves and the greener ones held until properly colored. Many of the wholesale dealers in tomatoes maintain repacking and ripening rooms during the shipping season. As the cars are received the tomatoes are sorted, and those requiring further ripening are placed in a room at a temperature ranging from 70° to 75° F., with suitable moisture conditions and held three to six days or sometimes longer, until they are ripe enough to be placed on sale. The usual method of maintaining proper moisture conditions in the ripening rooms is to place a few shallow pans of water on the floor in different parts of the room and by the use of small sprinkling cans to spray a little water over the paper wrappers of the green tomatoes that have been repacked. By maintaining proper moisture conditions there is very little loss from shrinkage in the weight of the tomatoes, and the fruits do not have a shriveled appearance when they become fully ripe.

Formerly, early green tomatoes were practically all packed on the farms where grown, but this system has now been largely replaced by packing in centralized sheds. Where the tomatoes are packed on the farm a temporary shelter or shed is usually constructed at one end or side of the tomato field. Sometimes a wagon shed or similar shelter near the dwelling is used. By the centralized packing method the grower is relieved of everything pertaining to packages and pack-

ing and simply delivers his product to the packing shed and receives a duplicate slip covering the weight or number of packages delivered, while the entire work of grading and packing is done by the packing-shed force.

Galvanized-iron buckets, half-bushel round-bottom stave baskets similar to those used for picking orchard fruits, 12-quart climax baskets, and 16 and 20 quart round hamper baskets are used for picking in the field. Of these the half-bushel round-bottom orchard baskets with broad collapsible wood handles are perhaps the most desirable. Where the tomatoes are transferred in the field from the picking utensils to lug boxes, bushel crates, or bushel baskets for hauling to the packing shed, great care must be taken in pouring them from one container to another, to avoid bruising. The interior of all picking utensils should be carefully inspected to see that there are no sharp edges, nail points, or rough surfaces to injure the fruit. Many growers follow the practice of lining their picking baskets with heavy muslin, light canvas, or burlap. Small breaks in the skin which may not be noticed when the tomatoes are packed often cause serious loss in transit and on the market. Field crates or lug boxes used for hauling the tomatoes from the field to the packing shed should be light in weight, but strong and durable. They should be provided with cleats across the top at each end to prevent bruising the fruit either in the wagon or in stacking at the packing shed. The lug box used for handling oranges from the grove to the packing shed in Florida is a desirable type, but it has the objection that it is too large for one man to handle. A good type of bushel box is, from many standpoints, better. Tomatoes should never be hauled in bulk, even though the wagon bed is well padded, as the weight of the fruit in a load 20 to 26 inches deep causes serious bruising and internal injury of the fruit.

Pink stock in the past has been packed more largely on the farms where grown than green stock, but recent developments have been along the line of centralized packing and handling. The methods used are practically the same as those for green stock, except that the pink stock is not wrapped in paper and must be handled with the least possible delay.

Early tomatoes grown in the Southern States are packed largely in such 6-basket carriers and 4-basket flat crates as are shown in Figures 19 and 20. The grades, packs, and type of package used for handling southern early tomatoes, which are shipped mainly to the northern markets, are fully described in Farmers' Bulletin 1291, entitled "Preparation of Fresh Tomatoes for Market," and the consideration of these subjects is therefore omitted from this publication. The methods of handling tomatoes grown for local sale in the Southern States as well as those of the producing sections in the Northern and Eastern States are, however, so different from those of the shipping sections of the South as to require description in this bulletin.

The degree of ripeness of tomatoes grown for the early and general markets in the regions outside of the intensive early sections of the South depends upon the locality and the method of delivery to the markets. Those grown in Tennessee, southern Ohio, and other sections of similar latitude and conditions are gathered in the ad-

vanced pink stage or when this color covers two-thirds or three-fourths of the tomato. In this condition the tomatoes will be ready for use by the second or third day after gathering and in many cases will keep from five to seven days in good condition. In sections where the tomatoes are hauled direct to the market and offered for sale within 24 hours of the time they are gathered, the fruits are allowed to become almost fully ripe upon the vines. Tomatoes that are grown for household canning as a rule are left on the vines to become uniformly red ripe but not soft or overripe. During the early part of the season while prices are high the plants are gone over every day or every second day, but during the height of the season the tomatoes are usually gathered about twice or three times a week.

The methods of packing tomatoes for local markets vary in different localities. Most of those grown for the early market, however, are gathered in field baskets and either hauled or carried to a central packing shed, where they are cleaned by means of soft cloths and then packed in baskets, crates, or whatever package is best suited to the market. Peck and half-bushel splint baskets with handles and 12-quart climax baskets are often used, especially during the earlier part of the season. In some sections the half-bushel round hamper is a favorite package. The New Jersey 20-quart crate is widely used in the Swedesboro and southern New Jersey sections for car-lot shipments of fresh tomatoes. A larger size, holding from 27 quarts to 1 bushel, is popular in northern New Jersey, adjacent to New York. These crates are usually made from unfinished material, presenting a rather unattractive appearance in the markets. They have the disadvantage that the weight of the fruit in the package frequently causes crushing of the bottom layers. They have the advantage, however, of being strongly made and seem to give satisfaction in the movement of low-priced stock to neighboring markets. The 20-quart brace hamper or round basket used in the Philadelphia and Baltimore districts for rail and boat shipments to canneries is very extensively used for marketing tomatoes. In most cases these baskets are nested together and returned to the growers. In the shipping sections of Ohio, Indiana, Illinois, and Missouri the 12-quart climax basket is used to some extent, but has the disadvantage that the handles are easily broken and that it is rather deep, and a single overripe fruit in the basket is liable to injure its entire contents. In the New England States the standard bushel or "Boston box" shown in Figure 21 is most generally used. The

FIG. 19.—Green tomatoes wrapped in special paper and packed in 6-basket carriers.

inside dimensions of this box are 17½ by 17½ by 7$\frac{1}{16}$ inches. When carefully packed with firm, smooth, uniform-sized tomatoes, this box holds 60 to 63 pounds.

The important consideration in the selection of a package for the local marketing of tomatoes is to secure one that is strong, of neat appearance, and that can be conveniently handled. Where the tomatoes are sold in the original package to families, the 4-quart flat basket, the 1-peck splint basket, the 12-quart climax basket, and the half-bushel round hamper are desirable packages. Tomatoes that are to be used for canning in the home are most conveniently delivered in half-bushel or five-eighths bushel round baskets or in standard bushel boxes or crates.

One important factor in the handling of tomatoes is that the containers and the wagon, truck, or other vehicle on which they are transported shall be adapted to each other. In many cases special racks or frames are built upon the wagons to carry the baskets or hampers. Standard bushel boxes are almost universally constructed so that they will pile one upon the other.

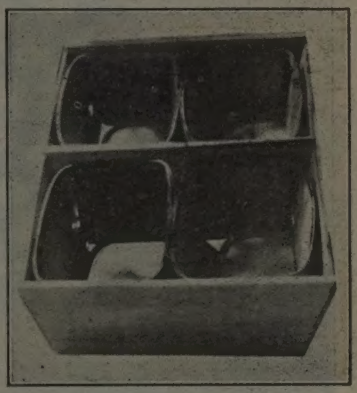

FIG. 20.—A 4-basket carrier used in some sections for shipping early tomatoes.

In the southern New Jersey early-tomato section the leading markets of the eastern United States are within truck-hauling distance, and a large part of the crop is delivered by motor truck. While the district around Swedesboro still holds a record for very heavy car-lot shipments, the building of hard-surfaced roads to Philadelphia and other eastern cities has made possible the hauling of 80 to 100 bushels at a truck load, and large quantities are moved in that manner. Tomato-growing sections that are located on the rivers and salt-water inlets ship by boat to a considerable extent. Water transportation, however, as a rule, is too slow for the handling of early or truck-crop tomatoes, and boats are used primarily for the transportation of those intended for canneries.

Adherence to the standard grades, as described in Farmers' Bulletin 1291, is of great importance from the standpoint of increasing the demand for table tomatoes. The southern grower can gain nothing by sending hundreds of miles to market culls that must be either discarded when re-sorted or sold at a price that will not pay transportation and handling costs. The term "culls" as used here includes all undersized and immature fruits, as well as those that are rough, cat-faced, and irregular; also those that are cracked and leaky and in such condition that decay sets in during transit. The centralized packing shed with expert graders and packers has gone a long way toward educating the growers (1) in the production of a high-grade product and (2) in the matter of proper gathering to leave the culls in the field and to bring only marketable stock to the

packing shed. Cases are known where individual growers have had less than 10 pounds of "rejects" from a whole day's picking of 3 to 5 acres of staked and pruned tomatoes.

In the northern sections, where the fruits are packed largely in the field or in packing houses located on the farms, it is extremely difficult to establish grades, and the result of this lack of uniformity and standards is reflected in the prices obtained. Cases have come under observation where high-grade tomatoes of superior quality, well packed in standard bushel boxes, were selling for $4.50 a box on the grower's premises, while miscellaneous, field-run tomatoes of another section which were dirty, lacking in uniformity of ripeness, and poorly graded were a drug on the same market at $1.50 per bushel.

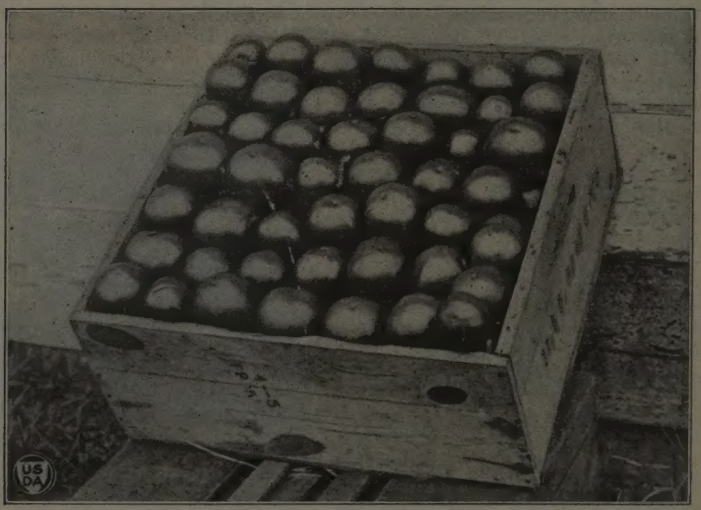

FIG. 21.—Tomatoes packed in a standard bushel box known as the "Boston box."

The grower of the high-grade tomatoes was making a handsome profit, while those who were producing the low-grade stock were complaining that there was nothing in the growing of tomatoes.

SUMMARY.

Profitable early-tomato production depends to a considerable degree upon the selection of soil of the proper character in a well-protected location, with good drainage and abundant drought-resisting properties.

Good seed of a variety and strain adapted to the purpose for which the crop is being grown is very important, and while seed of this character should cost very little more than ordinary seed the matter of price paid for the seed should be of secondary consideration.

The proper growing of the plants by means of hotbeds, coldframes, blocking off, and in some cases by the use of pots is essential to the production of a satisfactory early crop of tomatoes.

The intelligent use of manure and fertilizer and the thorough preparation of the soil are essential steps in profitable tomato growing. Frequent shallow cultivation and the spraying of the plants to protect them from insect and disease injury is essential.

Tomato plants should not be set in the open ground until all danger of frost is past, and earliness as well as yield depends to a considerable degree upon the care used in transferring the plants from the plant bed to the field.

Staking and pruning the plants is a distinct aid in the production of an early crop, but may not be practicable on a large scale. The proper maturity of the fruit, depending upon the distance from market and the method of handling, is highly important, and a knowledge as to when the fruit should be gathered must be gained largely by experience. It is the age rather than the size of the fruit that determines its stage of maturity.

The production of high-grade uniform fruit is essential, but the proper grading, packing, and marketing of the crop largely determine the profits.

Early and truck-crop tomatoes are now grown on a very large scale, approximately 120,000 acres of land being devoted to this phase of the tomato industry in the United States.

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